SPIRAL VIBRISSAE IN SOME CLUSIID FLIES (DIPTERA, SCHIZOPHORA)

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Abstract

Males of three Australian species of the family Clusiidae have the vibrissae modified to form a three-dimensional spiral. It is possible that such a modification, together with the broadening of the head, is of use in agonistic behaviour between rival males.

Occurrence and description

Males of some species of the family Clusiidae have the vibrissae (a pair of differentiated bristles on the anteroventral angles of the cheek region) larger than those of the females and curved in a three-dimensional spiral. These species are: *Clusiodes gladiator* McAlpine, *Parahendelia latifrons* McAlpine, and *Parahendelia nigriceps* McAlpine (see McAlpine 1960 for descriptions). In *C. gladiator* only the males with the more developed vibrissae, i.e. usually the larger individuals, exhibit the spiral curvature (Fig. 1), the vibrissae of the females and smaller males being simply incurved. In *P. latifrons* all males seen have spiral vibrissae, and some females show a less marked spiral structure. Only the unique holotype of *P. nigriceps*, which has spiral vibrissae, has been seen.

The term spiral is not here confined to the strict mathematical definition, but is used to include cylindrical helices (cylindrical geodetic lines) in addition (see Thompson 1917 for discussion of spirals in biology).

The spiral vibrissa presents a corkscrew-like, three dimensional curve, but describes only a single whorl through its entire length. The spiral is somewhat irregular and does not always extend to the basal part of the vibrissa. The spiral of both vibrissae is left-handed; that is to say each is the opposite or mirror image of the spiral seen in such familiar items as a screw thread, a corkscrew, or the shell of a garden snail. For this reason the pair of vibrissae does not exhibit symmetry about the sagittal plane of the head. The one vibrissa represents the approximate image of the other, and a condition of true symmetry is that the one half of the object (divided off by the plane of symmetry or sagittal plane) represents the *mirror image* of the other half. A further cause of asymmetry is the difference of phase at the basal commencement of the curvature between the two vibrissae, which, continuing through the length of the curve, results in the apex of one vibrissa (usually the left) being curved upwards, the other downwards.

Associated with the enlargement and spiral curvature of the vibrissae in these forms there is a variable degree of widening of the head. In males of *C. gladiator* the head of the male is only slightly wider than that of the female, the antennae being slightly more separated at their bases than in that sex. In the males of *Parahendelia* spp. the head is conspicuously widened and the antennae widely separated. The widening of the head in the males also occurs in the species which are dealt with by Frey (1960) in the genus *Hendelia* and Soós (1963) in the genus *Prohendelia*. Some of these have the vibrissae enlarged, but no mention is made of the curvature of the vibrissae.

Curved vibrissae are present throughout the family Clusiidae and in ma other families of higher Diptera (e.g. Piophilidae, Agromyzidae, Heleomyzid Muscidae). Usually the curve lies approximately in one plane and may sh slight deviations from the circular suggesting a plane spiral.

Parallels elsewhere in animal kingdom

Paired spiral adornments of the head occur in certain groups of Mamma and frequently are present in the male sex only, the adornments (horns, tusk being often absent or undeveloped in females. In this they resemble the abo mentioned clusiid flies in which the vibrissae are best developed and attain th spiral structure in males. In the family Bovidae of the mammalian ord Artiodactyla many species possess spiral horns. These horns may be eith spirally sculptured or their axes may be wound into a spiral curve. In every ca there is approximate symmetry of the pair in contrast to the asymmetric clusiid pair. If the left horn has a left-handed spiral then the right horn has right-handed spiral (homonymous forms, e.g. sheep); when the left horn has right-handed spiral, then the right horn has a left-handed spiral (heteronym forms, e.g. most species of "antelope").

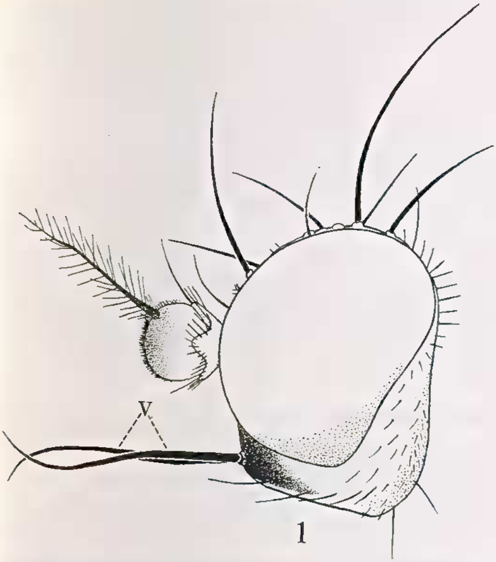
The only close parallel with clusiid spirals among the mammalia (o perhaps among the whole animal kingdom) is found in occasional ma specimens of the narwhal (*Monodon monoceros*, order Cetacea). The male this whale has usually a single long straight tusk produced by the hypertrop of one of a pair of teeth in the front of the upper jaw. The tusk shows str left-handed spiral sculpturing. Rarely the male has both teeth developed i tusks in which case the spiral sculpture of both is left handed.

I propose to use the term *bisinistral* to designate the kind of curvature twisting found in the paired cephalic processes of male *Parahendelia* s *Clusiodes gladiator*, and *Monodon monoceros*. The mirror image of t condition, which could be termed *bidextral*, is unknown to me in the ani kingdom.

Adaptive value

Conspicuous modifications of the male sex apart from the genitalia usually connected with attraction or excitation of the female or with fighting deterring other males which enter an established territory. The sexual behavi of the Clusiidae is not yet recorded. Representatives of some other acalypt families have comparably modified processes of the male head which are kno to be used in fighting other males of their species (McAlpine, 1975; Mou in press). The modification of males of *Pogonortalis doclea* (Walker) as descri by McAlpine consists of the enlargement of a group of bristles (not homolog with the vibrissa) on the cheek region of each side of the head, which engaged with those of an opposing male when fighting. As in the clusiids b considered, the male of *P. doclea* usually has the head broader than in t female. Some other flies with broadened heads in the male sex (*Zygothr* *Achias*, McAlpine unpublished) are known to engage the heads with one anot in fighting. Because the structural modifications of these clusiids so rese those of other flies, in which they are known to play a role in agoni behaviour, I consider it very probable that they are also adapted for fight

This supposition could explain the significance of the asymmetry m



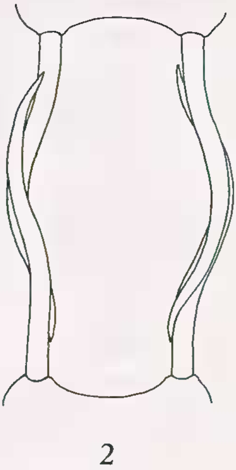


FIG. 1. Head of *Clusiodes gladiator*, ♂. v: vibrissae.
FIG. 2. Hypothetical diagram of the vibrissae of a pair of ♂ clusiid flies engaged in fighting. The vibrissae are thickened for clarity.

above. In an opposed pair of males the left vibrissa of one individual would be applied to the right vibrissa of the other. Hence the upwardly curved apex of the left vibrissa would slide over the downwardly curved apex of the opponent's right vibrissa. Because both of these are curved in a left-handed spiral, they can be closely applied over a considerable part of their length. This would not be possible in a hypothetical pair of flies both with an asymmetrical pair of homonymous (or both with heteronymous) vibrissae. In *Clusiodes gladiator*, as in *Pogonortalis* and other agonistic male flies, the adaptations for fighting are less developed in small weak males, which would be less likely to be able to utilise them to advantage. If the agonistic behaviour takes the form of attempting to force the rival from his footing on an area of substrate (as in *Pogonortalis* and *Zygothrica*), then it is apparent how the forces applied through the vibrissae could act. A fly with its left vibrissa applied to the dorsal surface of its opponent's right vibrissa and its right vibrissa applied to the ventral surface of its opponent's left vibrissa (Fig. 2) would be in a position to exert a torque through its opponent's vibrissae in a counter-clockwise direction (as seen from its own aspect). It is also in a position to receive such a force from its opponent in a clockwise direction. Because the two contestants would face in opposite directions, these same statements with respect to direction apply for each of them. The increased distance between the vibrissae of the individual, resulting from the widened head, would increase the value of the torque, according to the lever principle. The first individual to yield to the opposing torque would tend to be rolled over on its right side and could thus have difficulty maintaining a footing on the substrate.

After forcing the departure of its opponent from the substrate (perhaps well located leaf surface), the remaining male could be in a favourable positi for courting females.

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TIDE MARKS: A POORLY EXPLOITED COLLECTING SITE

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Tide marks, particularly on less developed beaches offer the entomolo and especially the coleopterist, a unique if rather leisurely method of collecti It is an area of potential collecting apparently ignored by most collectors, b visits to beaches often yield rewarding results.

Wave action has the effect of concentrating large amounts of float matter along beaches in long but narrow lines. Insects, even if living wh washed ashore, frequently remain near this line and the collector needs only walk along these distinct tide marks.

Tide marks represent to many beach scavengers a potentially impor food source and the intending collector therefore is placed in direct competi with them for any insect specimens deposited there. Ghost crabs, *Ocypode* s and gulls, *Larus* spp. are coastal scavengers commonly met with. In additi drying by sunlight and even the slightest breeze can quickly destroy and co tide marks and the specimens there. To overcome this to some extent an e rise is necessary if serious collecting is to be attempted.

Results from beach collecting are of interest when supplementary to ot collecting methods in the same district. For example, at Harrington, north Taree on the New South Wales north coast, where I have taken Coleopter lights for a number of years, *Anoplognathus pallidicollis* Blanchard has yet to taken at lights but examination of local tide marks in late November to January has revealed considerable numbers of this species. In contrast dynastid *Dipelicus duplex* (Sharp) has yet to be found along tide lines bu common in mid February to late March at lights in the same towns

Success depends greatly on prevailing weather conditions and the occ ence of high and low tides. Experience so far indicates that optimum tides app to be early morning 'highs' coupled with late afternoon low tides. Tide charts necessary if visits to beaches by entomologists planning to systematically w along these useful tide marks, are to be anything more than incidental.